

# Tumors of Salivary Gland Origin in Children \*

## A Clinical Pathologic Appraisal of 24 Cases

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OVER THE LAST 30 YEARS, through 1953, 470 neoplasms of salivary gland origin were operated upon by the plastic surgery service at Barnes Hospital (Table 1).

This series is unique in two respects. First, all of the patients were operated upon by a small group of surgeons, who have a similar concept of the management of these tumors. Second, all of the specimens were examined by a single pathologist (LVA) in an attempt to reduce some of the ambiguity which has plagued pathologic classification in the past.

Twenty-three, or five per cent of the patients, first noticed a tumor before the age of 18. This segment of the series has been studied independently to try to determine whether the tumors of childhood and young adults behave differently from similar tumors in later life. The patients have been divided into three groups: benign mixed tumors, malignant tumors, and tumors located within the region of the parotid but not arising from salivary gland tissue. The latter category is included because of the special diagnostic problems in an age group that is unusually susceptible to acute inflammatory lymphadenopathy and in which the lymphangiomas and hemangiomas of infancy have to be considered.

### MIXED TUMORS

Seventeen neoplasms were typical benign mixed tumors. Fourteen tumors were situated in the parotid gland, one in the sub-

maxillary gland and two were removed from the palate. None was found in the sublingual gland. Eleven patients were female, an incidence of two to one over the same lesion in males. Only two were in Negroes, of which one arose in the hard palate. The incidence was distributed evenly between the ages of seven and 18.

In this group, the diagnosis may be simple for an experienced surgeon but many inaccurate diagnoses may be made before the patient arrives at the hospital. For instance, a child was referred to the hospital for a broken jaw. The jaw had been fractured during attempts at extraction of an impacted molar tooth thought to be the cause of an enlarged cervical lymph node. The lymph node proved to be a benign mixed tumor of the parotid gland.

The presence of a lump was the reason for seeking medical attention in every instance, and in only one patient was there any pain or tenderness associated with the lump. Usually, the tumor had been present for one to three years but its growth had been so insidious that the child's parents had not bothered to have it investigated. The mass may have been noticed first during an upper respiratory infection which focused attention on the parotid and high cervical regions.

Physical examination revealed a smooth, rubbery mass located at the angle of the mandible, or in front of the ear. Some of the tumors were lobulated, but generally they were smooth and symmetrical. As usual in parotid tumors, the mass was described as feeling superficial, regardless of

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TABLE 1. *Salivary Gland Tumors*

Parotid Gland			
Mixed tumor	Benign primary	191	
	Benign recurrent	49	
Carcinoma	Malignant	14	254
	Epidermoid	29	
	Hypernephroid	2	
	Undifferentiated	24	
	Mucoepidermoid	18	
Adenocarcinoma	Simple	8	
	Papillary	2	
	So-called cylindroma	17	100
Papillary cyst adenoma (Warthin's tumor)	Unilateral	23	
	Bilateral	4	27
Oxophil adenoma (onkocytoma)		3	3
Region of parotid gland	Plexiform neurofibroma	1	
	Neurilemoma	4	5
			389
Submaxillary Gland			
Mixed tumor	Benign primary	20	
	Benign recurrent	5	
Carcinoma	Malignant	1	26
	Epidermoid	4	
	Undifferentiated	6	
Adenocarcinoma	Mucoepidermoid	2	12
	Simple	1	
	So-called cylindroma	9	10
Papillary cyst adenoma (Warthin's tumor)		1	1
			49
Arising from Salivary Gland Tissue in Other Locations			
Mixed tumor	Benign primary	12	
	Malignant	2	14
Carcinoma	Undifferentiated	2	
	Hypernephroid	1	
	Mucoepidermoid	2	5
Adenocarcinoma	Simple	1	
	So-called cylindroma	12	13
			32
Total			470

the portion of the gland involved. All of the mixed tumors were slightly movable and there was no fixation to overlying skin. The average size was 2 to 4 cm. in diameter. The largest tumor was 7 cm. in diameter and weighed 35 grams. There was no evidence of a facial nerve palsy in any patient.

Four children had been subjected to external roentgen therapy for two months before being referred to a surgeon. There

was no change in the size or appearance of the tumor following irradiation. Eventually, all of the tumors were excised, following a technic of combined tumor-nerve dissection avoiding tumor spillage. There were no postoperative nerve palsies, although three of the primary tumors were located beneath the facial nerve. All of the primary tumors were single and there were no bilateral tumors. The recurrent tumors, of which there were five, consisted of many

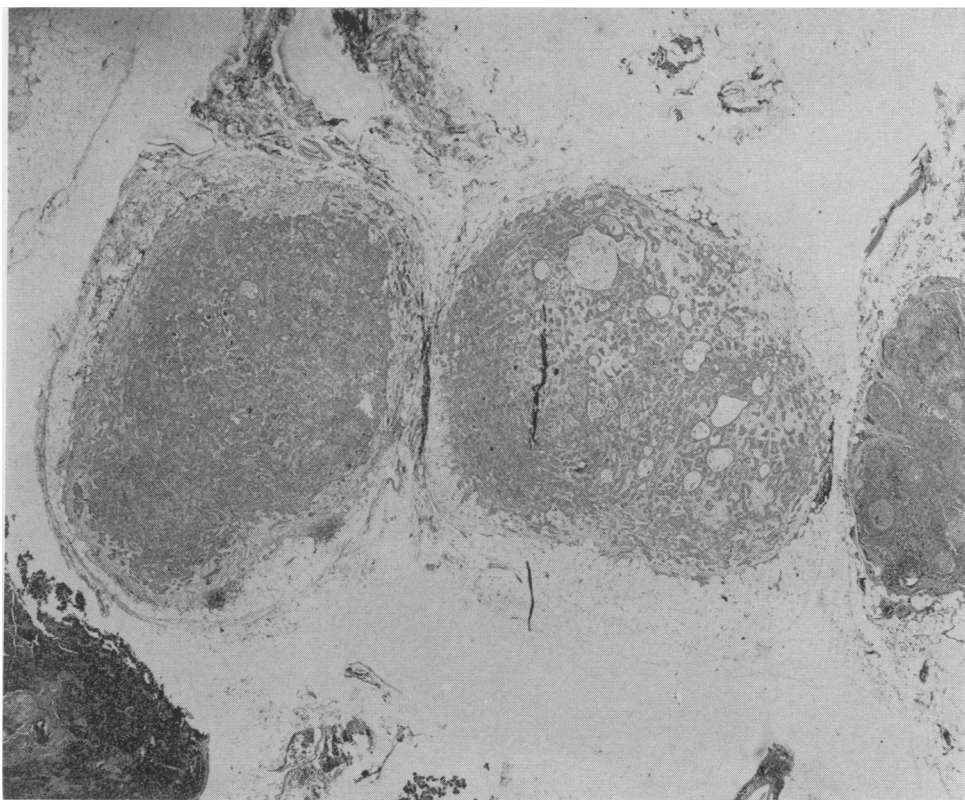


FIG. 1. Numerous well-demarcated nodules of persistent mixed tumor are seen. These nodules microscopically have a pattern of a mixed tumor, and resulted from seeding at time of incomplete operation. (High power. W.U. Negative #56-3719)

small nodules scattered throughout the surgical field (Fig. 1). Each of these was a separate nodule of mixed tumor and gave the impression of having been seeded at a previous operation. These nodules of persistent mixed tumor are well defined and often have the configuration of a lymph node, and reproduce faithfully the appearance of the tumor. Seeding was so extensive in one case of a recurrent submaxillary tumor that a supraomohyoid neck dissection was necessary to include all of the implants.

The tumors were firm in consistency and most of them appeared homogeneous on cut section. They were greyish white in color and some had streaks of yellow coursing through them. Eight tumors contained cartilage, A variable amount of mucinous

material was present and three of the tumors were actually cystic. Microscopic examination revealed a varying proportion of epithelium, fibrous stroma, cartilage and mucin. Large stellate cells dominated some areas and often highly cellular areas were present. Mitoses were rare.

Four of the patients with parotid tumors never returned to follow up clinic and no information about their postoperative course could be obtained. Of the ten patients with mixed tumors of the parotid and submaxillary gland who were followed, five are well after ten years and two have been followed over five years with no recurrence. The other three have been observed for less than five years but are free from recurrence at this time (Table 2). Four mixed tumors were recurrent when

TABLE 2. *Benign Mixed Tumors*

Patient	Location	Type	Follow-up
FMT	parotid	primary	27 years, no recurrence
PLC	parotid	primary	20 years, no recurrence
MAD	parotid	primary	14 years, no recurrence
MJM	parotid	primary	10 years, no recurrence
CM	parotid	recurrent after 10 years	10 years, no recurrence
MRB	parotid	recurrent twice at 3 and 6 years	8 years, no recurrence
JED	parotid	primary	7 years, no recurrence
RGR	parotid	primary	2 years, no recurrence
MLG	parotid	primary	15 months, no recurrence
EAS	parotid	primary	13 months, no recurrence
DDW	parotid	recurrent after 10 years	lost
BM	parotid	primary	lost
OLM	parotid	primary	lost
REP	parotid	primary	lost
AMD	hard palate	recurrent after 5 years	28 years, no recurrence
LP	hard palate	primary	7 years, no recurrence
RG	submaxillary	primary	recurred after 6 years, then after 7 years, no recurrence

first seen, having been previously operated upon elsewhere and it is important to note that two of these recurred as long as ten years following excision. The only recurrence of a mixed tumor among those operated on primarily, as far as is known, was of a submaxillary gland tumor. In this patient, multiple nodules appeared in the scar and beneath the surrounding skin after six years. The entire area was excised in the form of a supra-omohyoid neck dissection and seven years have elapsed with no further evidence of recurrence. Mixed tumors are notoriously easy to implant and characteristically recur as multiple nodules. We have no evidence that repeated inadequate excision alters their benign behavior in any way. Nevertheless, seeding can be so extensive throughout the operative area that a radical operation will ultimately be required to extirpate all of the disease (Fig. 2).

The patients who had mixed tumors excised from the palate have been followed seven years and 28 years respectively. One of these was a recurrent tumor which was excised first at the age of nine. Five years later the patient was seen because of a

lump beneath the operative scar. This was excised widely and was a typical persistent benign mixed tumor. Twenty-eight years later, the patient is free of any recurrence.

#### MALIGNANT TUMORS

Six tumors were malignant. This is an incidence of 26 per cent which is comparable to the incidence of malignant tumors in adults. Two neoplasms were so undifferentiated as to make it uncertain whether they were truly of salivary gland origin. Since they were discovered incorporated within the substance of the parotid gland, they were included in this group. Four of the cancers occurred in white girls and the other two in white boys. The youngest child was seven years old and the oldest was 15. No malignant tumors occurred in the other salivary glands.

Two features in the history of malignant tumors were found consistently enough to be useful as a differentiating point between benign and malignant lesions. These symptoms were pain and rapidity of growth. In contrast to the benign mixed tumors, which were nearly all painless, five of the six patients with malignant tumors went to a



FIG. 2. Multiple mixed tumors from seeding at time of inadequate operation and tumor spillage

physician with the chief complaint of pain. The pain was not severe, but was constant and is probably associated with the other differential point, rapid growth. One patient had symptoms for two years and another for one year but, with these exceptions, the rest of the children gave only a three to six month history of pain and rapidly enlarging lump. During this time, the tumor may have more than doubled in size.

Examination helped to confirm a suspicion of cancer only in that as a group the tumors were larger than benign tumors. Half of the tumors were larger than 7 cm. in diameter: larger than the biggest one of the benign mixed tumors. Also, the malignant tumors were frequently mildly tender to palpation. It is interesting that facial nerve palsy, so often depended upon as a sign of malignancy in adults, was not present in any of the cancers in children. Only one case had even a trace of facial weakness, and this was dated by the patient to a biopsy performed in a doctor's office several weeks prior to admission. If fixation

to surrounding structures can be demonstrated, it is a strong point in favor of malignant tumor but in this group there were only two tumors exhibiting fixation, and both of these were in the highly undifferentiated group. With the exception of size, the malignant tumors felt much the same as benign tumors.

Two tumors were extremely undifferentiated, highly malignant lesions (Fig. 3). Although these tumors were unquestionably located within the substance of the parotid gland, they may have been metastatic from the oropharynx, or even a lymphoma. Both tumors were excised. One had a limited excision with protection of the facial nerve, and the other had an extremely radical excision, including sacrifice of the facial nerve and complete neck dissection. Both patients were dead within 80 days after operation. They died at home and no autopsies were performed, but in both instances the last physical examination done within a few days of death revealed extensive carcinomatosis. Whether the surgical procedure hastened the demise of the patients is impossible to say on the basis of two cases, but it seems clear that the operation did not benefit either child and that the radical procedure was no more beneficial than the conservative one.

Three less malignant carcinomas were slightly smaller and had been present a little longer than the very undifferentiated lesions. One of these was an adenocarcinoma which was excised with preservation of the facial nerve. Unfortunately, this patient has been lost to follow up and no information is available concerning her postoperative course. Two patients were biopsied and found to have unclassified carcinoma. One of these was returned to her home for a course of external radiation. The dosage and details of administration are not available, but we did learn that the child died with generalized carcinomatosis 90 days after biopsy. The other patient with unclassified carcinoma was treated by

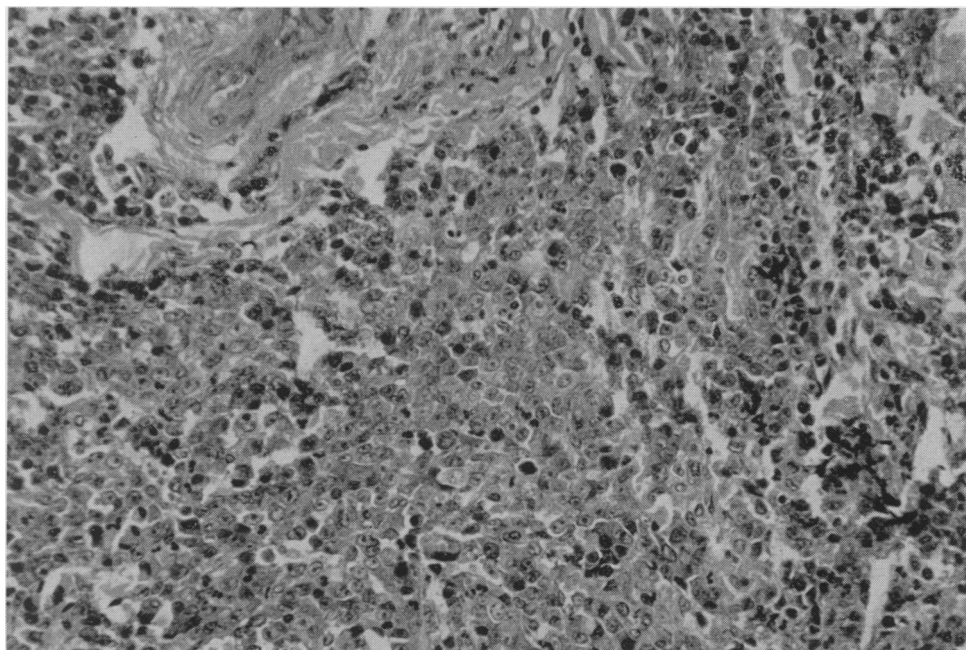


FIG. 3. Highly undifferentiated malignant tumor of parotid. Exact microscopic classification impossible. Patient died within 80 days following operation. ( $\times 310$ . W.U. Negative #56-3718)

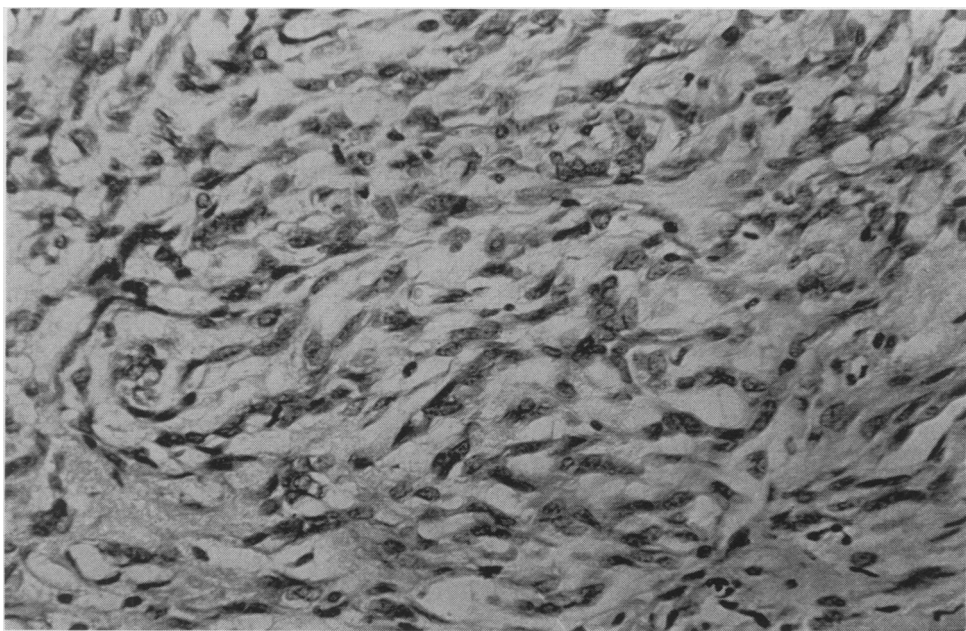


FIG. 4. This carcinoma is undifferentiated and cannot be classified. This patient has remained well for four years. (S.P. #52-2170)

implanting 25 one millicurie gold radon seeds into the tumor area (Fig. 4). This patient has been followed very closely and

four years later she is completely well with no sign of recurrence. No external radiation was used.

TABLE 3. *Malignant Tumors*

Patient	Type	Treatment	Followup
WBB	undifferentiated carcinoma	limited excision	dead in 62 days
FYD	undifferentiated carcinoma	radical excision	dead in 80 days
MAT	unclassified carcinoma	external radiation	dead in 90 days
DS	adenocarcinoma	limited excision	lost
ECB	unclassified carcinoma	interstitial radiation	well, with no recurrence 4 years
TDK	mucoepidermoid carcinoma	limited excision	well, with no recurrence 14 years

One patient had a mucoepidermoid carcinoma, which was unusually well circumscribed and was excised with a margin of normal parotid gland. The facial nerve was preserved and a neck dissection was not performed. Fourteen years later the patient is free from recurrence and is probably cured. See Table 3 for course of malignant tumors.

In another instance, a patient had a large cystic lesion in the region of the parotid with extreme squamous metaplasia of the duct and this was originally mistaken for a mucoepidermoid carcinoma. Review of these sections makes us feel that the changes are non-neoplastic (Fig. 5). This patient is well ten years after the use of interstitial radiation.

#### OTHER TUMORS OCCURRING IN THE PAROTID GLAND

There were seven tumors that did not arise from salivary gland tissue, but were found within the substance of the parotid gland and suspected of being mixed tumors preoperatively. These tumors are presented to call attention to the fact that they do occur in this location in children, and to point out certain of their characteristics which can be used to differentiate them from mixed tumors.

One patient reported a three month history of generalized swelling of the face which gradually resolved into a single 2 cm. mass just in front of the left ear. This mass had the same physical properties of a mixed tumor but presented a very unusual physiological finding. Pressure directly over the mass produced a very thick "glarry" secretion from Stenson's duct. At operation, the mass was discovered to be a diffuse hardening of the whole gland and no discrete encapsulated mass was found. Biopsy revealed chronic inflammation and microscopic changes consistent with Mikulicz's syndrome.

Another case presented the problem of an irregular, lobulated mass resembling tuberculosis. Extensive preoperative investigation was normal and a biopsy was performed. The entire gland and facial nerve were found to be involved by a rough, irregular, non-encapsulated tumor. Microscopic section revealed a typical neurofibroma of the plexiform variety. This condition should have been suspected when a moderate size "café au lait" spot on the affected side of the face was found. Nine years later the patient reports no further growth of the lesion. Two patients had neurofibromas in the region of the parotid gland. The most important preoperative finding was multiple tumors, a situation which was not seen in any primary mixed tumor. One patient had other neurofibromas elsewhere on her body.

There were three cases of hemangiomas within the parotid gland. Two of these were capillary hemangiomas and the third was cavernous. Both of the capillary lesions occurred during the first six months of life, which is of diagnostic significance in that the youngest patient with a salivary gland tumor was seven years old. As Howard<sup>6</sup> has indicated, this type of hemangioma has an excellent prognosis. The third hemangioma was a cavernous type and did not appear until the age of 11. These patients did not have any other vas-

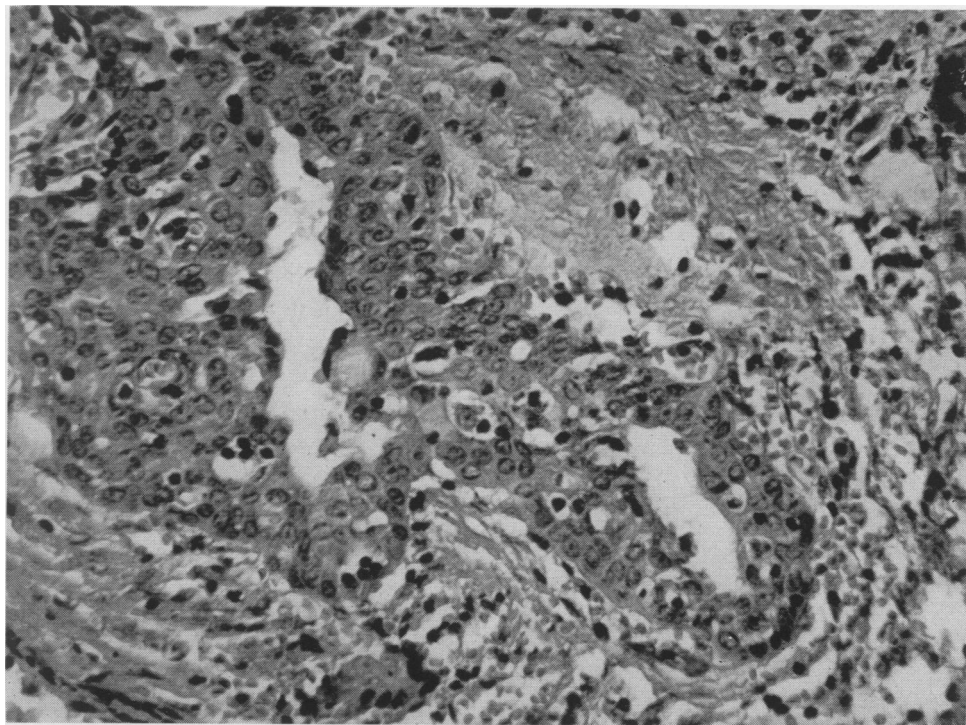


FIG. 5. There is prominent squamous metaplasia of a moderate sized duct. These changes were originally mistaken for a well-differentiated mucoepidermoid carcinoma. ( $\times 310$ . W.U. Negative #56-3717A)

cular anomalies or other visible hemangiomas.

The incidence of malignant salivary gland tumors in adults is usually given as around 25 per cent. In our over-all series, malignant tumors comprised 33 per cent of the adult tumors. This slightly higher incidence is probably attributable to the fact that benign tumors occurring within the gland, but not arising from salivary gland tissue, were excluded from the total series. Such tumors include lipomas, fibromata, hemangiomas, etc. An incidence of 26 per cent cancers in children, therefore, indicates that tumors of childhood have about the same statistical chance of being malignant as in adults. In this series there appears to be a tendency for malignant lesions to occur in white females. There were no bilateral tumors in children and multiple tumors occurred only as recurrent ones as the result of seedings.

In the diagnosis and surgical treatment of salivary gland tumors, the problems are similar whether the patient be an adult or a child. Therefore, we have felt that it would be advisable to outline the indications and limitations of incisional and needle biopsy and to describe briefly the surgical approach.

#### PRINCIPLES OF MANAGEMENT

Preliminary biopsy should be done when experience and judgment indicate the necessity for it and the benefit to be gained outweighs its dangers. In cases where cancer is suspected and either a radical operation or radiation therapy is being considered, biopsy is mandatory. Difficulties associated with biopsy are seeding the tumor, damage to the facial nerve, and failure to obtain a representative section of tissue. Seeding is a serious problem and any biopsy tract, whether incisional or needle, is

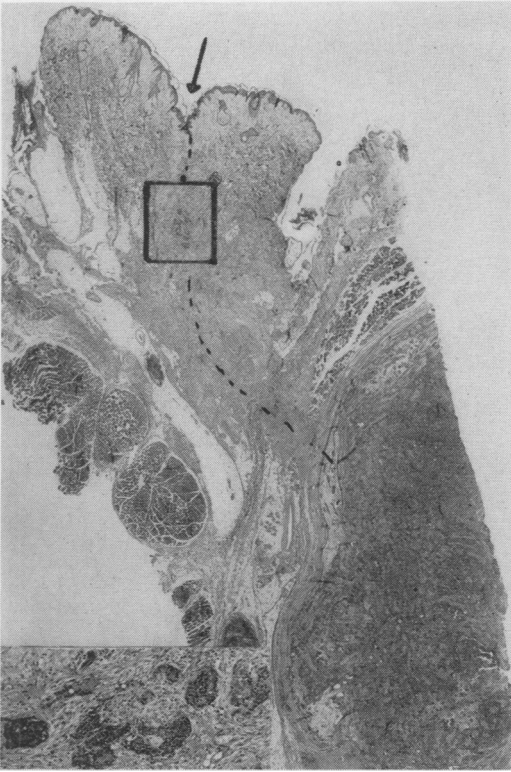


FIG. 6. This photomicrograph demonstrates a nest of tumor cells implanted in a needle tract of aspirated biopsy. The arrow indicates skin at point of penetration. The dotted line is the needle tract as indicated by scar, foreign body reaction, and recent healing. The rectangle outlines a clump of tumor cells within the needle tract. Insert lower left is high power view of same area. The substance of the tumor is lower right.

inevitably contaminated with tumor cells (Fig. 6). Therefore, incision and puncture sites must be planned so that they can be excised completely during the course of a subsequent operation. During an incisional biopsy, it is important to avoid turning back flaps or performing extensive lateral dissection. When these precautions are exercised, the danger of seeding can be reduced. The intimate relation of facial nerve and tumor is the basis for another objection to routine preliminary biopsy. In three of the mixed tumors the tumor was found directly beneath the nerve. Two of these patients entered the hospital with a partial facial paralysis, dated to a preliminary bi-

opsy. On the other hand, fear of damaging the nerve is often responsible for inadequate biopsies which completely miss the tumor.

Some physicians have felt that the objections to incisional biopsy might be obviated by needle or punch biopsy. We have attempted needle biopsies which also have certain disadvantages. In the first place, the needle must hit a diagnostic area and the operator must be experienced. If needle biopsy is done, tumor can extend along the needle tract as we have demonstrated (Fig. 6). Therefore, if a definitive operation is done later the entire tract must be excised. Indiscriminate needling of a salivary gland tumor might seed a large area, which would be impossible to excise at a definitive operation. It is true that if the tumor is highly undifferentiated, an epidermoid carcinoma or even a metastatic melanoma, the diagnosis is relatively simple from the material obtained by needle biopsy. If a diagnostic area in a Warthin's tumor with characteristic lymphoid tissue clothed by oxyphilic cells is obtained, then diagnosis will not be difficult. If fluid alone is obtained an error can be made in the cytologic interpretation of the cells. A mixed tumor can be identified usually without difficulty. However, in the type of tumor in which it is most advantageous to have a correct diagnosis we have made several errors and this is in the so-called cylindroma group. These tumors are well differentiated and may even have double layering of cells in the acini, so that an erroneous diagnosis of mixed tumor is made. We have therefore, reserved needle biopsies for special situations, realizing fully the dangers and possible inaccuracy.

Frozen section diagnosis of undifferentiated neoplasm or epidermoid carcinoma is usually not difficult. In several instances frozen section diagnosis has been helpful in identification of a Warthin's tumor suspected of being malignant on clinical examination. In other instances it would seem contraindicated to incise a tumor which

could be much better excised with a margin of normal salivary gland tissue. Interpretation of highly cellular mixed tumors is difficult for inexperienced pathologists. In most instances it is much better judgment to await well prepared, permanent sections.

#### OPERATIVE TECHNIC

Adequate technics for removal of parotid tumors have been well documented in the past.<sup>1, 2, 3</sup> The principles are: complete exposure of the gland through an adequate, well planned incision; identification of the facial nerve, and removal of the tumor, without spillage, with a surrounding margin of normal gland where possible, this being accomplished by simultaneous nerve and tumor dissection. These objectives are easiest to accomplish under general endotracheal anesthesia with the drapes arranged to expose the entire side of the face. Figure 7 illustrates the incision. After the anterior skin flap has been reflected, a member of the operating team is designated to watch the face and instantly report any twitches of the facial muscles. Tumor removal is accomplished by careful dissection through normal parotid tissue. A tiny curved hemostat is very useful to spread tissue and each fiber in facial nerve territory is individually tested by lightly squeezing before it is divided. As the nerve is approached, it will either be visualized or the operator will be warned by twitches of the facial muscles. One of us (LTB) has described a method of identifying the lower branches of the nerve by its remarkably constant relationship with the posterior facial vein.<sup>4</sup> Other methods are identification of the main trunk of the nerve, or identifying peripheral branches as they are approached in the dissection of the tumor. Once the nerve has been positively identified, a simultaneous nerve dissection and tumor removal can be carried out. This is done by inserting a hemostat along the nerve and opening it to create a tunnel be-

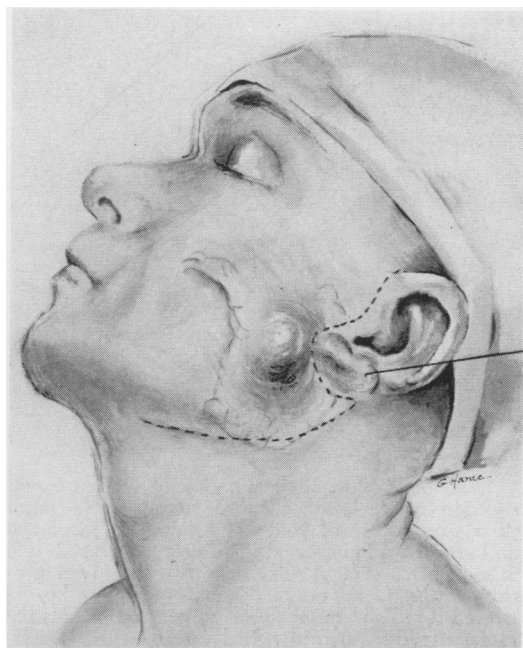


FIG. 7. Incision which permits adequate exposure of operative field and results in minimal visible scar.

tween the nerve and parotid tissue. When the nerve filament is close to tumor the dissection is on the nerve and not on the tumor, thus providing the greatest possible margin of safety. The anatomy of the nerve within the gland is such that virtually every mixed tumor in the body of the gland displaces the nerve in some direction. After the tumor has been removed, some portion or all of the peripheral distribution of the nerve may be exposed in the depth of the wound (Fig. 8). Extreme caution must be exercised to test every suspicious fragment of tissue, because an expanding tumor can flatten or otherwise distort a nerve so that it is not recognizable as an important structure. Gentle mechanical stimulation with a hemostat has been a satisfactory method of stimulation. Electrical stimulation tends to activate too much of the nerve at one time and is not as accurate for localization of specific branches. Unintentional damage to the facial nerve was not a complication in any of the cases operated on by this method.

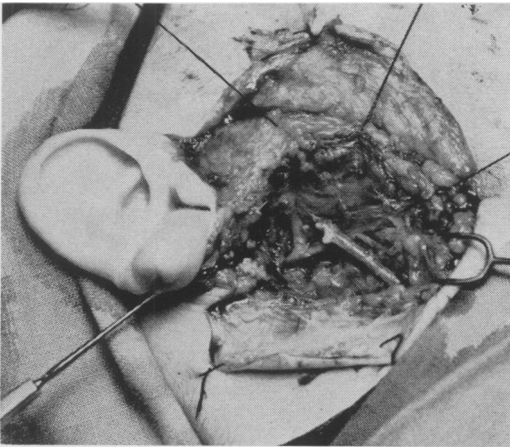


FIG. 8. Wound at termination of benign tumor excision by technic of simultaneous nerve-tumor dissection. Most of the facial nerve is displayed and seen to be uninjured. The posterior facial vein is seen in its typical relationship to the lower portion of the facial nerve. Each tumor may be expected to displace at least some portion of the facial nerve in an individual fashion.

Gustatory sweating was not a problem following any of our operations in children in spite of the fact that no effort was made to interrupt the sudomotor efferent nerve fibers between the facial nerve and the cutaneous nerves of the face. However, gustatory sweating was noted in some of the adults.<sup>5</sup> Salivary fistulas occurred infrequently and were only temporary.

It has been said that all tumors of the parotid gland should be excised by total parotidectomy, because the pathologic diagnosis is unimportant if a complete excision of the gland has been accomplished.<sup>7</sup> Reasoning such as this completely ignores the pathology of parotid tumors and will inevitably lead to serious complications and a high percentage of recurrence.

It must be realized that an expanding tumor, benign or malignant, pushes the facial nerve before it and the two become so closely approximated that it is necessary to dissect the nerve from the tumor surface if it is to be preserved. To accomplish a total parotidectomy and still preserve the nerve, the gland must be removed in a fragmentary manner and not as a block dissec-

tion. Regardless of the amount of gland removed, the dissection has gone much too close to the tumor in the event of malignancy. It is obvious, therefore, that the belief that one can do a radical block removal of the gland and yet save the nerve is inaccurate. Benign tumors of salivary gland origin should be removed by a technic of simultaneous nerve and tumor dissection which calls for visualization of the portion of the nerve close to the tumor and its dissection away from the tumor as the operation progresses. Total parotidectomy with facial nerve preservation for a benign process is difficult and all too frequently some portion of the nerve is damaged. The only reason for this procedure would be a multicentric origin of benign tumors for which we have no pathologic evidence.

#### DISCUSSION

Simultaneous nerve and tumor dissection may be regarded as an excisional biopsy without tumor spillage. If the preoperative diagnosis of benign tumor is subsequently proven histologically, an adequate operation has been done. If a diagnosis of mucopidermoid carcinoma or cylindroma is returned, on a small, apparently localized, tumor, our tendency has been to do nothing more, if in the judgment of the surgeon and the pathologist the tumor was excised adequately. Some comfort can be derived in this instance from the knowledge that cylindromas are radiosensitive. If the sections show undifferentiated, highly malignant carcinoma, the surgeon is faced with the problem of whether to proceed with a radical operation or resort to palliative radiation. If the tumor is less malignant, the case for radical operation is strengthened, particularly if the diagnosis was made by means of an incisional biopsy through a small incision that can be completely excised. When carcinoma is discovered during or following a nerve-sparing operation where flaps have been turned back, etc.,

one must assume that the entire field has been seeded with cancer cells. In this unfortunate situation the entire wound must be excised.

#### SUMMARY AND CONCLUSIONS

1. Twenty-three, or 5 per cent, of a series of 470 salivary gland tumors occurred in patients below the age of 18.

2. Twenty-six per cent of the tumors were cancer and showed a predilection for white females.

3. Pain and rapid growth were characteristics of malignant tumors not found in benign lesions.

4. Facial nerve palsy was not seen in children with either benign or malignant growths.

5. The age of the patient, the presence of abnormal secretion, and the finding of associated lesions such as café au lait spots are useful in distinguishing tumors of salivary gland origin from tumors which are found within the gland but not arising from it.

6. The advantages and dangers of preliminary incisional and punch biopsies are presented.

7. The operative technic for total excision of benign parotid tumors with preservation of the facial nerve is outlined.

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